MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2015/2016

TCI2261 – COMPUTATIONAL INTELLIGENCE I

(All Sections/Groups)

16 OCTOBER 2015
03:00PM – 05:00PM
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 3 pages (including cover page) with 6 structured questions.

2. You must attempt any **FIVE out of SIX** questions. The distribution of the marks for each question is given.

3. Please print all your answers in the answer booklet provided.

Question 1

(a) Briefly describe any THREE of the computational intelligence components and state its origins in biological systems. (6 marks)

(b) What are the TWO types of associative memory? Briefly explain and give an example for each of it. (4 marks)

Question 2

(a) Briefly compare any THREE differences between Radial Basis Function neural network and Multilayer Perceptron neural network. (6 marks)

(b) Briefly discuss the FOUR major components of Self Organization. (4 marks)

Question 3

Given the following training samples, initial weight vector *W0* equal to (1, 1, -1), and the learning rate equal to 1.

Training Samples

	in_0	in_1	in_2	in_3
p0	1	-1	-1	1
p1	1	-1	1	1
p2	1	1	-1	1
p3	1	1	1	-1

Suppose sign activation function and perceptron learning are used:
(a) Draw the network architecture. (2 marks)
(b) Compute the final weights after one epoch. (8 marks)

Question 4

(a) Consider $R_1 \in X \times Y = \begin{bmatrix} 0.7 & 0.2 & 0.4 \\ 0.3 & 0.1 & 0.8 \\ 0.5 & 0.9 & 0.6 \end{bmatrix}$ and $R_2 \in Y \times Z = \begin{bmatrix} 1.0 & 0.2 \\ 0.7 & 0.3 \\ 0.8 & 0.0 \end{bmatrix}$.
Compute the Max-Min composition of $R_1 \circ R_2$.

(6 marks)

(b) Illustrate and describe the steps of the Mamdani fuzzy inference process for *contrast* and *brightness* in image enhancement. (4 marks)

Continued.....

Question 5

(a) Let the input vector of a Counter Propagation Network be $x = [x_1\ x_2] = [5\ 12]$. Normalize the input vector. (4 marks)

(b) You are asked to select an implementation technology for a numerical processor. Computation throughput is directly related to clock speed. Assume that all implementations will be in the same family (e.g., CMOS). You are considering whether the design should be implemented using medium-scale integration (MSI) with discrete parts, or multichip modules (MCM). Define the universe of potential clock frequencies as X = {2, 3, 4, 5} MHz, and define MSI, and MCM as fuzzy sets of clock frequencies that should be implemented in each of these technologies, where the following table defines their membership values:

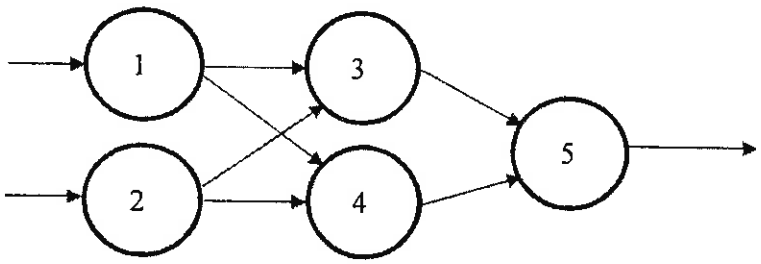
Clock Frequency (MHz)	MSI	MCM
2	1	0.5
3	0.5	0.7
4	0.3	0.2
5	0.2	0.4

Representing the two sets as MSI =M and MCM=C, find the following: (6 marks)

i. $M \cap C$
ii. $\bar{C}$
iii. $C|M$
iv. $\overline{M \cap C}$
v. Core of M
vi. $M_{0.5}$

Question 6

The architecture of the Backpropagation Neural Network is shown as below.



Assume that the neurons are using *Sigmoid* activation function, the target output is equal to 0.7, and learning rate is set to 1. The weight of the neural network $[w_{13}\ w_{14}\ w_{23}\ w_{24}\ w_{35}\ w_{45}]$ is set to [0.1 0.2 0.2 0.1 0.3 0.4]. Given an input vector [0.2 0.5], compute the following:

(a) Perform a forward pass on the network. (4 marks)
(b) Perform a backward pass on the network. (6 marks)

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